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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/249,292	02/12/1999	TETSUO ONO	503.36911CX1	9771

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EXAMINER	
OLSEN, ALLAN W	
ART UNIT	PAPER NUMBER
1763	24

DATE MAILED: 03/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

AS-24

Office Action Summary	Application No. 09/249,292	Applicant(s) ONO ET AL.	
	Examiner Allan W. Olsen	Art Unit 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 December 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 24-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 and 24-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/30/2002 has been entered.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 30 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 30 requires that the total number of high energy and low energy ions out number the ions with intermediate energy by a factor of at least two. Applicant's December 02, 2002 response states at page 6, lines 2-5, that it is apparent from Fig.4 that the number of high and low energy ions is at least twice the number of ions in the intermediate energy range. Applicant cites figure 4 of the originally filed application as providing the necessary support for this newly added limitation.

However, a quick triangulation of the area under the high, low and intermediate ion energy regions in figure 4, shows that this newly added limitation does not find support in figure 4. The determination of the area in each energy region was, admittedly, performed rather quickly, nevertheless, the area of the intermediate energy portion was determined to be about 170 relative square units. Therefore, in order to satisfy the limitation of claim 30 the combined area of the high and low energy regions would need to be at least 340 relative square units. However, the area under each of the high and low energy regions of the graph is about 144 relative square units, which provides a combined area of only about 288 relative square units.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 1 and claims 24-30, by virtue of their dependency upon claim 1, are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites a limitation including the phrase, "at one period ...in which anisotropy is high".

The term "high" in the phrase " anisotropy is high" is a relative term which renders the claim indefinite. The phrase " anisotropy is high " is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1 and 24-29 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. 5,352,324 issued to Gotoh et al (hereinafter, Gotoh).

Claim 1, as amended, does not include any new limitations, in the sense that all of the present limitations have previously been presented as part of claim 1 or in a claim that was dependent upon claim 1. Therefore, the previous rejection is maintained and is restated as follows:

Claim 1: Gotoh teaches a method of etching a substrate. Gotoh's method includes applying a RF bias with a frequency of 1 kHz or more to the substrate support (column 8, line 12). The RF bias power supply is independent from the power supply that is used for generating the plasma. Gotoh method includes providing the RF biasing power intermittently or on-off modulating the RF bias power.

Claim 1 - incorporated content of original claims 5-7: Gotoh's figure 9 is a timeline for a process that is divided into several steps (for example, just etching and over etching). The figure shows that, within the first half of the process, the bias power is modulated. During the first half of the process, the nitride to oxide selectivity is lower than it is during the second half of the process. See also column 10, line 59 – column 11, line 3.

Claims 1 and 29: include limitations pertaining to the ion energy distribution profile. Claim 1 requires the frequency of the applied bias to be such that the distribution of the plasma's ion energy includes a peak in each of the high energy and low energy regions.

Applicant's figure 5 is a graph profiling the ion energy distributions that are obtained from the application of two different bias frequencies. When a high biasing frequency is applied (e.g. 100 kHz) the graph shows that there are many high energy ions and many low energy ions, that is, the distribution of ion energies is largely bimodal in character. A comparison of Applicant's figures 4 and 5 shows that when the bias frequency is changed from the 100 kHz of figure 5 to the 1 kHz of figure 4, an ion energy redistribution occurs such that the bimodal distribution obtained from the 100 kHz bias *almost* disappears. However, the graph of the ion energy distribution that results from applying a bias frequency of 1 kHz includes the same two maxima that are present in the graph of the 100 kHz bias. Therefore, Applicant's figure 4 demonstrates that the 1 kHz frequency of Gotoh is sufficient to provide a saddle-shaped profile for the ion energy distribution and therefore, is sufficient to meet the limitation of claim 29.

There is one limitation of claim 1 that was not explicitly taught by Gotoh. As explained below, the examiner considers this limitation to be inherent in Gotoh's method.

Instant claim 1 requires that the peak to peak voltage of the modulated bias power be set to a level such that the etching rate that is obtained with a modulated bias power is equal to the etching rate that is obtained with the continuous application of a smaller peak-to-peak voltage bias power. The examiner maintains that the application of bias power increases the rate of etching and that the rate of etching modulates in conjunction with the modulation of bias power. The bias-off periods correspond to periods with a lower etching rate. Therefore, modulation of the bias power leads to an

overall decrease in the rate of etching when compared to a continuous bias etching process. On the other hand, increasing the peak-to-peak voltage of the bias power increases the rate of etching. Therefore, to satisfy the limitation of claim 1, that requires a bias power modulated process to have the same etch rate, that would be obtained using a continuous bias power, the reduction in etch rate, brought about by modulating the bias, must be compensated for by increasing the peak-to-peak voltage of the bias power.

Claims 24-28: Figures 4a and 7 and column 6, line 18 – column 9, line 41 of Gotoh address the limitation of claims 24-28. Gotoh's method is applied to anisotropically etch a 0.5 μm feature into a substrate. The method is described and shown to provide features with vertical sidewalls and flat bottoms. Gotoh teaches using a frequency for the on-off modulation of the bias power that is lower than the actual frequency of the RF power itself.

Response to Arguments

Applicant's arguments filed December 02 and December 31 have been fully considered. As they are not persuasive, the arguments are addressed by the above rejections.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 703-306-9075.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck, can be reached on 703-308-2333.

The general fax numbers for TC1700 are 703-872-9310 (non-after finals) and 703-872-9311(after-final).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0661.

Allan Olsen, Ph.D.
February 26, 2003